

Natural Rhenium Isotope Variations

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Analyses of industrial and natural Re, expressed as $\epsilon^{187}\text{Re} = [({}^{187}\text{Re}/{}^{185}\text{Re}_{\text{smpl}}/{}^{187}\text{Re}/{}^{185}\text{Re}_{\text{std}}) - 1] \times 10,000$ with $\epsilon^{187}\text{Re} = 0$ provisionally defined as ${}^{187}\text{Re}/{}^{185}\text{Re} = 1.7025$ [1], show ‰-scale isotope variation. External reproducibility of standards is currently ~ 2 ‰ units.

Re is extracted and purified from sample powders with an aggressive leach and anion chromatography. Column-induced fractionation occurs, but is unimportant due to quantitative recovery. Solutions with 20 ng Re g⁻¹ are analysed by MC-ICP-MS (ThermoFinnigan Neptune) after doping with natural W to exponentially correct for instrumental fractionation (${}^{186}\text{W}/{}^{183}\text{W} = 1.98594$; [2]). ${}^{189}\text{Os}$ is monitored to correct ${}^{187}\text{Re}$ for ${}^{187}\text{Os}$ when necessary. Re-rich samples with unknown but very large ${}^{187}\text{Os}/{}^{189}\text{Os}$ are stripped of Os by sparging. Other interferences, tailing, and sample matrix effects are insignificant.

Standards prepared in house from high-purity commercial Re and HReO_4 are identical ($\epsilon^{187}\text{Re} = -26$), while an Alfa Aesar Re standard has an $\epsilon^{187}\text{Re}$ of -28.

Natural samples consist of sulphides, shales, and water samples from an acidic pit lake. Sulphides show ~ 1 ‰ variation from $\epsilon^{187}\text{Re} = -20$ (Archaean MoS_2) to a modern rheniite ($\epsilon^{187}\text{Re} = -29$). Variably-weathered Devonian black shales span $\epsilon^{187}\text{Re}$ from -28 to -32. Acid pit waters from both surface and depth (-76 m) are isotopically indistinguishable ($\epsilon^{187}\text{Re}$ of -27 and -28).

Detection of natural Re isotope variations mandates a careful study of their utility as a geochemical tool. As Re has no known biogeochemistry, comparison with Mo and Se could prove useful as Re may quantify the strictly abiotic proportion of isotope fractionation.

References

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Fine-scale isotopic structure in OIB trends: New insights from São Jorge Island, Azores

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Sr, Nd and Pb isotopic compositions (and, at a lesser extent, Os, Hf, He) of Oceanic Island Basalts (OIB) are commonly used to constrain the nature of mantle sources. However, isotope variations measured in OIB can be related either to variable proportions of the various components present in the deep source of basalts, or to interactions between pristine melts and the environments encountered during their ascent to the surface. Therefore, extracting the part of shallow-level processes from the global geochemical signature of OIB is a key to retrieve the source information and to investigate mantle topology in greater details. Consequently, fine-scale studies of OIB, at a single island or archipelago scale, are mandatory.

Here, we present a detailed study of São Jorge Island, Azores archipelago. We report new major-, trace-element concentrations and Sr-Nd-Pb isotope ratios measured for 22 basaltic samples covering most geological formations of the island. We observe variations in agreement with previous studies of the whole archipelago; notably our samples plot on the Pico-Terceira trend that was already documented in the different isotope variation diagrams. We also reveal the existence of a fine-scale structure of isotopic data best evidenced in the ${}^{208}\text{Pb}/{}^{204}\text{Pb}$ vs. ${}^{206}\text{Pb}/{}^{204}\text{Pb}$ plot. Our samples indeed draw two sub-parallel trends corresponding to distinct Sr and Nd average values, defined as the unradiogenic (low ${}^{87}\text{Sr}/{}^{86}\text{Sr}$, ${}^{143}\text{Nd}/{}^{144}\text{Nd}$ and ${}^{206}\text{Pb}/{}^{204}\text{Pb}$) and radiogenic (high ${}^{87}\text{Sr}/{}^{86}\text{Sr}$, ${}^{143}\text{Nd}/{}^{144}\text{Nd}$ and ${}^{206}\text{Pb}/{}^{204}\text{Pb}$) trends. This isotopic grouping shows a complex relationship with the geographical location of basalts. The radiogenic trend is composed by samples all collected on the eastern part of São Jorge. Conversely, the unradiogenic trend brings together basalts coming from various locations on the island. We will discuss these observations in terms of shallow-level vs. source information in a context of plume-ridge interaction.